telework

a status report

W. Cukier
L. Truuvert
Teleconference Consultants

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For additional copies, write:
Transportation Energy Management Program
Ministry of Transportation and Communications
Room 324, Central Building
1201 Wilson Avenue
Downsview, Ontario
Canada M3M 1J8
(416) 235-5037

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1/ introduction

Telework refers to the use of telecommunications/ information technology to permit individuals to work away from their place of employment [1]. This can include satellite work centres, which are essentially electronically linked branch offices of one company; neighbourhood work centres, which provide resources shared by employees from several companies; work at home, which may or may not be technology based; and flexible working arrangements, which involve occasional telework.

A number of advantages and disadvantages have been identified for both employees and employers. Although case studies of telework are few, a number have been well documented and reflect varying degrees of success.

The substitution of telecommunications technology for transportation has potentially wide-ranging impacts on energy consumption, industrial organization, economy, and society. In Canada, the potential impacts have not been studied in detail. Studies have been commissioned by the Ontario government, but in the absence of concrete examples of telework, most research has remained on a theoretical level [2,3]. The governments of the US, Hawaii, and California have commissioned studies to evaluate telework's potential impacts, particularly, on energy conservation. The findings of these studies have some relevance to the Canadian situation, at least in general terms.

2/ potential teleworkers

Traditionally, work at home was confined to certain occupational groups, with varying degrees of status – writers, artists, consultants, music teachers, crafts people, housekeepers, babysitters, seamstresses, and door-to-door sales people – typically, performing independent, autonomous tasks requiring limited capital investment.

With changes in technology, the electronic office is altering conventional notions of work, time, and space for an increasingly large segment of society: the knowledge workers. While low-tech activities have always been relatively portable, and many people have worked at home on a long report one time or other, the evolution of communications and information systems is making the movable office a reality. People no longer have to be in the same space to work together: with the growing capability to move information and ideas, the potential for decentralized work and telecommuting has increased dramatically.

In a recent study commissioned by the California Energy Commission [4], it was argued that the greatest potential for telecommunications substitution lay with information workers, those individuals whose primary work functions involve creation, collection, handling, and/or manipulation of information:

- knowledge producers – scientific and technical workers and private information services;

- knowledge distributors – educators, public information disseminators, and communications workers;

- market search and co-ordination specialists – information gatherers, planning and control workers;

- information processors – electronic and non-electronic based;

- information machine workers – electronic and non-electronic machine operators and telecommunications workers.

In California, knowledge workers are estimated to constitute 58% of the work force.

Different classes of workers are affected in different ways: managerial and professional staff with independent responsibilities and a fair amount of autonomy are on one end of the scale; machine tenders – programmers and clerical staff – are on the other [5]. Studies of how workers actually spend their time are revealing. Most of the activities they are engaged in could be accommodated with electronic technology.

It has been estimated that managers spend approximately 14% of their day writing [6]. While many professionals occasionally spend a day or two working at home to complete a project without distractions, they are usually not aided by electronic technology. Computers with communications technology make it possible to create documents and transmit them to a central office or to edit on-line. In addition, many companies already have telephone-based dictation systems in place. Managers call into the word processing centre from their office, whether this office is in the same building or 30 km away. Electronic mail can be used for sending messages and memos to other subscribers. In1984, Bell Canada estimated that 10% of its Envoy 100 subscribers had access to the system from home [7].

Telephone calls, which absorb 16% of their day, can be made from home, although access to company networks such as tie lines or WATs may be restricted. With call-forwarding, calls can be automatically rerouted. Answering machines and voice mail, already common in businesses, also make the worker's location irrelevant. One restriction on work at home is the number of phone lines available – callers may be more frequently faced with busy signals.

Formal and informal meetings absorb more professional time than any other activity, as much as 47% of the day. Certain types of meetings require face-to-face interaction, notably where negotiations, bargaining, motivation, or sensitive political matters are involved. However, telephone calls, audio, and computer conferencing can meet the communications requirements for a large percentage of meetings, as much as 64% by some estimates. One of the most important selling points for "meet-me" audio conferencing is that participants do not have to be in a prearranged location. They can call in from the office, home, or a phone booth.

Of course, some meetings fulfil more than just information exchange – casual discussions with colleagues are an important way of of tapping into an organization's informal communication system and maintaining professional contacts, support networks, and visibility. Isolation from peers is one of the chief disadvantages cited by home-workers. While some people are content to work at home exclusively, most require period face-to-face contact with superiors, subordinates, and co-workers, which cannot be replaced electronically. Also, because of the complex nature of supervising, motivating, and "leading" staff, it is difficult for managers to manage people exclusively at a distance. This is a problem both for the home-worker with staff in head office and for the head office managers with staff working at home. For most people, whether a superior or a subordinate, some face-to-face contact with others is essential. Because of the complexity of their responsibilities, few professional staff work exclusively at home, although many do some of the time. Satellite offices, which are structured like conventional offices, require less adaptation and are often preferred over homework by employees who want to sustain social and professional relationships with co-workers.

Professional and management workers also spend a portion of their day reading correspondence, reports, data, and other forms of information. While some of this information can be provided either through access to data bases or even facsimile machines, the paperless office is a myth. The most difficult aspect of telework, from a technology standpoint, is access to information resources. People are still heavily dependent on files, books, reports, and written correspondence. Some physical transportation of documents is necessary in most cases.

Many of the daily tasks performed by clerical workers are also location independent. Typing absorbs over one-third of the average day for a secretary and speaking on the phone another fifth. The tasks which can most easily be accommodated at home are those which are defined and independent. Tasks which rely on face-to-face interaction with other people or access to hard-copy documents are more difficult. As a result, most of the clerical workers who work at home perform single tasks, such as word processing or data entry. A number of typesetting

3/ extent of telework

firms, for example, rely on home-workers to reduce their overhead and enable them to meet fluctuating demand. Because of the marginal position of clerical workers, homework presents possibilities for exploitation, and many critics raise the prospect of home sweat shops. Home-workers are often paid on a piece-rate basis, with little job security, few benefits, and are usually not unionized.

The tasks of computer programmers and other employees whose work is "terminal-based" are easily done at home, particularly where the output is fairly well-defined.

What actually counts as telework is the subject of much discussion, as is the extent of the phenomenon. In 1975 it was estimated, for example, that approximately 3.2% of the American labour force worked at home [8]. However, in 1982, it was estimated that only about 10 000 US workers were telecommuting, and of these, only 1000 worked exclusively at home [9]. In other words, while work at home may be extensive, it would appear that the use of telecommunications to substitute for travel is not. Whether or not this potential will be realized remains to be seen, but some researchers predict that about 18% of the work force will be telecommuting within a decade [10]. Nilles estimated that 10 million will telecommute by 1990 [11]. Others predict it will affect one-third of the work force by 1990 [12], but most of this is expected to be on a part-time basis.

4/ technology

Although the trend towards telework is by no means as clear as some futurists would have us believe, the significant decreases in the costs of technology (particularly work stations and computers), expanding software, combined with increasing communications capabilities (teleconferencing, electronic mail, document transmission), and the development of shared data bases are creating more opportunities both for work at home and increased decentralization in industry.

5/ advantages and disadvantages of telework

5.1/ The Employee

Most work-at-home arrangements are informal and voluntary. It does not suit everyone, as many people would prefer to work away from home as would like to work at home. Some people want to get away from home: in one study, 31% felt that working at home would improve their relationshipwith their spouse, whereas 35% thought it would have a negative impact. A majority felt that it would positively affect their relationship with their children, and flexibility in raising a family is certainly one of the principal reasons why some people want to work closer to home. F International, a software development firm, employs about 600 people, mostly women with children, who work at home, half using computers linked by phone lines to clients' computers or to the company's computer centre. It may offer other advantages as well. Reduced commuting costs (time and money) can be significant, particularly near large urban centres where commuting can easily consume over 10% of a person's waking hours. Telecommuting has also been made available to improve access to the work place for handicapped people or employees unable to travel because of illness or injury. American Express Project Homebound is aimed at providing employment to people who would not otherwise work. Best Western has established a booking centre in the Arizona Centre for Women, a minimum security prison, to cope with peak periods [10]. Some users see freedom from work-place distractions as an important benefit and believe that they can accomplish more at home than at the office. However, partly because of the discrepancies in individuals' attitudes to telework, virtually all work-at-home arrangements are voluntary.

There are, needless to say, disadvantages as well.

- For some people, social interaction at work is an important aspect of job satisfaction, and it can also be important in terms of professional development. Isolation from peers and lack of visibility are common complaints. Working at home may reduce chances for promotion and cut the home-worker off from important informal sources of information in the company. Some teleworkers have abandoned work at home for this reason.

- New kinds of interruptions must be dealt with, particularly if there is not a defined work space. There are also difficulties arising from the lack of separation

between home and work: when does the workday end and leisure time begin? Many of the productivity improvements associated with telework may be the result of employees working more hours as a result of never leaving the "office." While in some instances it is seen as an antidote to job-related stress, telework can also significantly increase stress by making it impossible to escape the office. Some researchers hypothesize that the separation between home and work is valuable and that the journey from home to work provides for the transition between roles [13].

• Finally, there is some potential for exploitation, particularly among disadvantaged and less mobile groups, who may be forced to accept lower rates of pay, benefits, and job security than their work-in-the-office counterparts.

5.2/ The Employer

From the employers point of view, telework offers certain advantages. Overhead costs and space requirements may be reduced for some organizations when workers are shifted to offices in less expensive suburban areas or their homes. Interstate Type, for example, a typesetting-based business which relies on remote workers, estimates that it would cost about three times as much to have the work done internally [14].

In addition, companies can attract personnel who would not otherwise be available. In some instances telework has been introduced to deal with potential shortages of staff [15]: for example, Control Data installed word processors in the homes ofemployees who might otherwise drop out of the work force, in effect, offering employees the option of telecommuting to reduce turnover. Increased productivity is another benefit which both teleworkers and their managers cite. At the Federal Reserve Bank of Atlanta, for instance, flexible work arrangements and organizational changes are credited with a dramatic, almost10-fold, increase in productivity [16]. Blue Cross and Blue Shield of California estimated that 16 home-based clerical employees were 50% more productive than office workers. Control Data reports average productivity gains among its home-workers of 35% [10].

One of the main problems with telework perceived by managers is the problem of measuring productivity. While few organizations have effective ways of measuring productivity in the office, they are at least reassured by being able to see their subordinates working, irrespective of what they are actually doing. This is less of a problem for professionals who are perceived as more self-disciplined than lower ranking personnel.

6/ implementation issues

Because it is still relatively new and the applications and configurations can differ dramatically, little has been written on how to establish telework systems. Most satellite and neighbourhood offices are modelled on conventional offices: all that changes is the location. Work at home, on the other hand, involves a redefinition of work/home space and poses more complex changes.

6.1/ Identifying the Applications

Obviously, telework is most easily implemented in organizations which are already automated with terminals, networks, and established data bases. Industries suited to telework are those which are information intensive and have information technology systems in place: banking, insurance, computer, finance, and educational institutions. Jobs which are relatively autonomous, with well-defined tasks, deadlines, and specific "products" seem most appropriate to telework. Independent individuals who are highly self-motivated and manage their time well are probably most interested in and best suited to work at home, although with certain tasks, the job is well-defined enough to create the structure needed for less disciplined individuals.

6.2/ Costs

The costs of telework include the hardware, transmission, and overhead. With satellite offices and neighbourhood work centres, the costs are still borne by the employer, although they may be reduced. With work at home, on the other hand, the employee usually assumes the overhead costs, although the employer may pay for terminals and transmission charges. In some jurisdictions, tax laws allow the employee, under certain circumstances, to calculate and deduct overhead expenses, including a portion of his/her mortgage or rent, telephone, hydro, heating, etc. In some jurisdictions, these allowances only apply if the home-worker is self-employed (i.e., subcontracts to various employers) rather than a salaried employee.

6.3/ Legal Aspects

Zoning laws and regulations must be investigated in detail. In addition, the application of workers compensation, labour laws, and so on may differ in their application to office workers and home-workers.

6.4/ Security/Privacy

Security and privacy are issues not only with respect to transmitted information but with hard-copy documents and files. Obviously, all of the measures employed in an office environment (pass keys, security guard, surveillance systems) cannot easily be applied to the home environment, although access codes and encryption techniques can be. More importantly, the home environment may present serious new threats (sticky fingers, spilled milk, fire, crayons) which are not faced in the conventional office, and these must be addressed in the implementation of a work place in the home. Again, as satellite or neighbourhood offices are usually modelled on conventional offices, there is less difficulty applying the same techniques.

6.5/ Technology

Obviously, the success of telework projects depends largely on selecting and implementing systems that can accommodate the workers' needs in a cost-effective manner. It may not be possible to provide them with access to 100% of the services available in the central office, but careful analysis of their requirements is important. In some instances, particularly where sources of information are not all online, arrangements to pick up, share, and distribute files must be made. In general, residential telephone systems are not designed to support long holding times, and in some areas, extensive transmission of data may present a problem. Compatibility of hardware and software is an obvious issue. Moreover, the number of telephone lines required (personal, voice, data) for work at home must be evaluated. The allocation of work versus home costs can present an added level of complexity.

6.6/ Organizational Arrangements

The technology alone does not make telecommuting work. It must be supported with an organization structure, policies, and procedures which do not penalize the teleworker. Regularly scheduled call-ins or progress reports may be useful, particularly in the early stages, partly to reassure supervisors. New and innovative performance measures may be required. While the immediate reaction of many supervisors, particularly of clerical workers, is to return to piecerate or key-stroke-based methods of renumeration,

this has met with opposition of workers and unions who fear the emergence of new forms of exploitation. In addition, an effort must be made to reduce the isolation of the teleworker by promoting regular contact with co-workers through telephone calls, conference calls, and periodic face-to-face meetings.

6.7/ Adoption

As with any new technology, decentralized work requires a burn-in period. Careful consideration must be given to training and orientation with respect to performance measures, expectations, policies, and procedures. Some suggest that initially, with telework, there is a significant drop in productivity as the employee adapts to the new systems and environment. For this reason it is important to clarify expectations and evaluation criteria and time frames before commencing. Most agree that work at home is most satisfying for most people, on a part-time basis, and this is certainly the form that is expected to become most prevalent in the near future.

6.8/ Space

If possible, there should be a physical separation between the work and living spaces, partly for psychological reasons, partly for practical reasons: a door is useful to keep intruders out and valuable documents in. The ingredients of a comfortable and productive work environment are the same whether at home or in an office building: good lighting, good air circulation, temperature control, and well-designed furniture are important. A badly designed work space can have a more negative impact at home than at the office because it is easier to choose not to work, without formal structures imposed by the office. Homeworkers who have set up offices in dark, damp stuffy basements may find their productivity suffering significantly.

7/ potential impacts

7.1/ Energy Savings

Because the adoption of telework is affected by a wide range of factors it is not possible to estimate its impact on energy consumption in Ontario without further research. However, in a 1984 report sponsored by the Ontario Ministry of Transportation and Communications, Ata Khan estimated that satellite work centres had the potential to reduce local travel and energy consumption by 36 to 144 million litres per year [2]. He estimated that work at home could save an additional 43 to 216 million litres (Appendix A). Based on scenarios and assumptions about full-time and part-time telework, the California study projected net energy savings of 202 million gallons of gasoline, about two days worth or 2% of annual consumption in the year 2000 [4] (Appendix B).

7.2/ De-urbanization

Increased telework opportunities might increase the numbers of people who choose to live outside of urban centres because of reduced property values, recreational activities, quality of life, and so forth.

7.3/ Travel Patterns

Peak traffic loads would likely be reduced in proportion to the number of telecommuters. Traffic congestion would be reduced. Local travel might increase as people would have more flexibility in their use of time.

7.4/ Land Use

Industries might choose to locate offices in rural areas because of reduced overhead costs, lower taxes, and access to labour sources.

7.5/ Environment

Air pollution would be reduced in proportion to the reduction in commuter travel. The California study estimates a 5% reduction in vehicle emissions by the year 2000.

7.6/ Economy

It has been argued that substituting telecommunications for transportation may play a vital role in competing for employees in high-tech industries. In ad-

dition, telecommuting technologies may become an industry in themselves.

7.7/ Employment Opportunities

Telecommuting is expected to increase opportunities for disadvantaged groups, including the disabled and unemployed single parents. Overall, telecommuting is expected to increase the total number of information jobs and to decrease the number of transportation jobs. While some jobs may be lost as a result of the productivity of remote workers, new job opportunities will likely offset these losses.

7.8/ Social Impacts

In addition to providing increased access to work for less mobile segments of the population, telework may present significant opportunities for improved quality of life, particularly for people who wish to maintain a non-urban life-style or integrate family responsibilities with a career. The potential for exploiting workers with the new technology must not be ignored, but to date, it appears that most telework projects have been voluntary and have increased opportunities rather than reduced them.

7.9/ Organization of Work

Brandt suggested that, on a conceptual level, the location of workers ranges from spatial concentration (central office building) through progressively more dispersed arrangements, including satellite work centres, which are essentially electronically linked branch offices of one company; neighbourhood work centres which provide resources which are shared by employees from several companies; flexible working arrangements which involve intermittent telework; and work at home [17]. He suggests that the trend is towards decentralization, both in terms of spatial arrangements and authority. Other futurists have maintained that further decentralization of work is inevitable and will dramatically loosen employer/employee connections to an extent which will significantly redefine the whole notion of corporate identity [18]. "Tenured" employees will likely be replaced by loosely connected entrepreneurs who sell their services to the highest bidder.

8/ factors affecting the adoption of telework

8.1/ Nature of the Job

Not all jobs lend themselves to telework; further study is required to define the parameters of specific jobs in specific sectors which are most easily adapted.

8.2/ Cost/Benefits

In a time of underemployment, the benefits of telework may appear to accrue more to the employee than to the employer, at least in the initial stages. Clearly, many of the companies that have introduced telework maintain that there are benefits in terms of increased productivity, reduced overhead, etc. However, for large, established companies the benefits may appear too nebulous to warrant the effort required, particularly in a recession. While the costs for certain forms of telecommuting may be relatively low, there are indirect costs to be considered, such as the cost of establishing the organizational arrangements, training, etc., required to make telework successful.

8.3/ Cost Factors

The cost/benefit assessment is affected by a number of variables, including the cost of technology, travel, personnel, and overhead. Clearly, the costs of technology are falling dramatically, while the costs of travel, personnel, and overhead are rising. The trend is expected to continue and make telecommuting more attractive to industry.

8.4/ Awareness

In Canada, virtually nothing has been written on the potential applications of telework, its advantages, or disadvantages. There is very little in the way of guidelines to help prospective users evaluate and implement telework. Only recently, in the USA, have publications appeared dedicated to telecommuting. While some very successful case studies have been documented, these are not widely known. For most, telecommuting remains a futuristic concept.

8.5/ Organizational Factors

It is no surprise that telework pilot projects have tended to be introduced in high-tech and consulting companies characterized by innovation and relatively

9/ case studies

loose organizational structures. Traditional organizations tend to be more highly structured, with conservative management styles predominating. One of the main impediments to telework is the notion held by many managers that they cannot supervise their employees if they cannot see them. New attitudes to supervision and new forms of performance monitoring are required.

8.6/ Social Developments

Social developments are contributing to the growing demand for more flexible work arrangements; in 1981 almost 10 million workers had flexible work schedules and compressed work weeks [19]. The increasing number of people juggling family and full-time careers, changing family values with more emphasis on shared parenting, and the increasing divorce rate are contributing factors. As more people seek alternatives to urban living, the cost and inconvenience of commuting increases, adding to the demand for more flexibility home/work arrangements.

8.7/ Other Issues

Other impediments to the adoption of telework relate to issues discussed earlier, including the limitations of the technology, accounting principles, and security concerns.

Although telework has received a fair amount of coverage in the press, the number of documented projects remains fairly small.

9.1/ State of California

The State of California, which employs 145 000 people, is the first government agency to proceed with a formal telework project [20]. The state plans to spend approximately $1.7 million on a pilot project. Two hundred employees of the General Services Office of Facilities will be involved in the project over a two-year period. A variety of professional and occupational groups will be involved. The objectives of the project are to reduce office space requirements and save energy.

9.2/ Interstate Type

This New Jersey-based typesetting business hires remote workers who work independently, from 10 to 40 hours per week [21]. While they may use different types of personal computers, the same type of software is used. The remote workers are in clusters and have a leader whose home is the drop-off and pickup site. The company estimates that it would cost approximately three times as much to do the work internally because of overhead. The other advantage is that the company can adjust to variations in work flow relatively easily: internal resources can be used more effectively for complex projects and rush jobs.

9.3/ Publishers Data Base

Another typesetting firm in Virginia uses remote distributors to solicit typesetters to work in their communities [21]. Remote workers require a personal computer and Publishers Data Base's (PDB's) typesetting code.

They key in the document to be typeset and then transmit the file over the telephone lines to PDB. The finished product is then mailed back to the customer. High-volume customers may key in the document themselves and transmit it to PDB. The advantages of this system are that rates are reduced, turnaround time is improved, and customers have greater flexibility.

9.4/ Federal Reserve Bank of Atlanta

In less than three years, productivity in the research department of the Federal Reserve Bank of Atlanta has grown by an estimated 920% due to combination of technology, new management, and flexible work arrangements [22]. The research department is organized into eight teams consisting of three economists, two research analysts, two student interns, and two secretaries. Each professional agrees to research 2000 hours per year. No specified number of hours has to be spent in the office, but staff must be accessible by telephone and attend pre-scheduled meetings. With the reorganization and flexible working arrangements, staff produce more reports for a wider audience more quickly and efficiently.

9.5/ Public Service Company of New Mexico

The Public Service Company of New Mexico has integrated telework with its standard business practices, primarily to supplement the work its management and professional staff do in the office [23]. Approximately 15 senior managers have Wyse terminals in their homes, and 25 to 30 more managers use their own personal computers for work at home on nights and weekends. Many of the data processing personnel also have terminals at home to reduce the need to come into the office to cope with operational problems in the middle of the night. The company also provides loaner terminals to employees who want to work at home on occasion or have short-term disabilities.

9.6/ Canadian Pacific Limited

Canadian Pacific (CP) of Montreal has supplied home computers to a few dozen senior managers and technicians so they can resolve problems that develop in the middle of the night without going into the office [7]. A terminal was also provided to a secretary with a broken hip to enable her to continue to work at home.

9.7/ Tymshare (MacDonald Douglas)

This company employs 5000 people, including 200 consultants, project managers, sales and marketing personnel, who work almost exclusively at home [24]. About 40% of the remaining staff spend one to three days a week working at home. The company provides a personal computer on loan and covers telephone expenses. Although the program is not formal, it has been in existence for several years.

9.8/ New York Life Insurance

Between six and 12 data processing personnel of this company work at home on contracts [25]. It is estimated that these employees are 33% less expensive than in-house staff. Standard equipment includes an IBM 3101 and Datastream T1 Modem. Most of the home-workers are former employees who are contracted on an assignment-by-assignment basis.

9.9/ Control Data

The company established an alternate work site program which included the employees' homes, a neighbourhood work centre, and satellite offices with shared services. Computers and telecommunications technology are used to permit data base access from virtually any point to virtually any other point [1]. The original 60 participants included analysts, programmers, educational course ware writers, and clerical workers; their work is project and task oriented. Typically, employees complete about half their work at the alternate sites. While overhead costs have been reduced, the major benefit cited has been improved productivity stemming from reduced travel time, increased motivation, reduced stress, and reduced distractions. Teleworking is treated as a benefit and has, according to Control Data, improved recruiting and retention of employees. Participants are selected on the basis of three criteria: the worker wants to telework, the work lends itself to telework, and the manager of the worker understands and supports to concept. The greatest obstacles stem from managers' difficulties in monitoring workers when they can't see them. From the employees point of view, the greatest problem is loss of contact and visibility. Both workers and managers must promote open and complete communication to offer teleworkers opportunities to participate in meetings, in training programs, and to provide ongoing feedback.

9.10/ Travelers Insurance Company

The company's data processing division is highly decentralized, with small centres staffed by programmers and managers who live in the immediate area [26]. Each centre is equipped with remote terminals. The greatest difficulty with the arrangement has been measuring programmer productivity. The advantage to workers is reduced commuting time, and the company feels it is able to recruit better staff. Management feels that productivity is increased because there are fewer distractions and staff are more motivated.

Eight programmers responsible for maintaining corporate data bases have terminals provided for home use.

9.11/ Freight Data Systems

The company provides turnkey systems, software, and time-sharing systems to trucking and other companies with large freight operations [26]. Seven programmers have access to terminals at home on evenings and weekends or other occasions, but they do not routinely work at home. Travel for staff is reduced by about 15%, but the benefit to the company is improved productivity.

9.12/ Atlantic Research Associates

This group of scientists in Nova Scotia consults on technology management and software design [27]. Using personal computers to prepare reports, they can also access the National Research Council's Canadian On-line Inquiry System, which in turn, gives them access to the National Technical Information Service in Washington. They are able to prepare reports without leaving their homes. The advantages they cite include flexibility and fewer distractions. The disadvantages include lack of personal contact.

9.13/ Seybold Consulting Group Inc.

Seybold Consulting Group Inc. publishes reports on office, professional computing, and publishing systems [28]. All of the employees except production and support personnel work out of their homes. They have standardized on communications equipment, including IBM personal computers. Face-to-face meetings are held quarterly, but employees rely heavily on voice mail and computer conferencing.

9.14/ Ontario Blue Cross

Ontario Blue Cross is one of the few Canadian companies known which has formally experimented with work at home [29]. In March 1984, nine terminal operators had terminals installed in their homes to enable them to access and input data remotely. It is estimated that the productivity of home-workers increased 8 to 10% and that absenteeism substantially decreased. The project was, however, terminated despite its success, because system changes reduced the transmission speeds for remote access and input. The company decided not to undertake the substantial capital investment required to continue the project.

9.15/ Pacific Bell

Sixty employees at Pacific Bell are participating in the company's telecommuting program, and the number is expected to rise to 200 by the end of 1986 [30]. Participants include programmers, analysts, engineers, planners, product managers, and forecasters who have chosen to telecommute for a variety of reasons. The company provides implementation support and orientation for the telecommuter and his or her management. The company provides satellite offices with access to headquarters through the public telephone system or local area networks (LANs). In addition, some employers work at home.

9.16/ Other Projects

Other documented cases of telework projects are listed in the following:

- Blue Cross and Blue Shield employ 16 home-based employees, who are, on average, 50% more productive than "office workers." Minimum daily outputs are established [10].

- American Express established telework to accommodate homebound and handicapped employees [10].

- Best Western Hotels established a booking office at a the Arizona Centre for Women, a minimum security prison, to help cope with peak periods. As many as 53 inmates have been employed [10].

10/ references

• New York Telephone established a pilot project involving 24 managers for two years and documented an average productivity increase of 43% [10].

• FMC Corporation provides terminals to employees so they can handle problems during the night without coming into the office [8].

• Heights Information Technology Service Inc. is a data processing company which employs 180 employees to write programs. Most work at home [8].

• Lift Corporation, a non-profit organization, has trained about 30 handicapped employees to write computer programs from their homes for a variety of clients [8].

• Office Systems Consulting Group employs 30 consultants who spend about 80% of their time on the road. They use portable terminals to write client reports and transmit them to a central computer [28].

• First National Bank of Boston provides terminals to select employees to allow them to solve emergencies or provide information at nights and on the weekends [28].

• Continental Illinois National Bank tried an experimental program in which workers were required to be at their terminals between core hours. Productivity was measured according to the quality and quantity of output. The project was discontinued after four years because it was not proving cost effective and there were transmission problems [28].

• Wave III Inc. trains retirees as computer programmers and then employs them on contracts in Florida and Washington [31].

• DARCOM, the US Army Readiness and Development Command at St. Louis, placed four workers offsite for 24 hour coverage of data processing [31].

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11/ annotated bibliography

Ancipink, Patricia, "Home Sweet Office," *Best Review*, pp. 58-60, May 1980. Telecommuting is appropriate to information-intensive industries such as insurance and banking. Project- and results-oriented people with experience on terminals are most suited to telework. In addition, it presents challenges to traditional business practices.

Anonymous, "Experiences with Telecommuting," *EDP Analyzer* 20(11):1-16, November 1982. The forms of telecommuting and projects at Control Data and F International are reviewed. Management of remote workers requires new techniques. The concerns of teleworkers include advancement, benefits, and organization of work at home.

_____, "Telecommuters to Get Village of Their Own in California." Three housing developers are setting up "Eaglecrest," a telecommuters development where an estimated 700-plus people could telecommute. Some people believe "Eaglecrest" to be ideal for self-starters, since it is intended to attract people interested in living in such an environment. One estimation suggests that large companies could possibly have up to 15% of their work force at home within the next five years.

_____, "The Electronic Cottage Comes of Age," *Management Review*, March 1984. This article presents a brief reference to pilot studies done; gives favourable responses; and lists types of jobs most suitable (including management, not just clerical) to telework. It also lists the cons: it is not for everyone; productivity does not increase immediately; an orientation program is necessary; it requires security; it is not full-time; and it must comply with regional laws. It also refers to the study done by Electronic Services Unlimited (ESU), a group of consultants specializing in telecommunications.

Arnst, Catherine, "Paperless Office Awaits IMB's Network," *The Globe & Mail*, April 18, 1984. Arnst reports on the anxious market, waiting for IBM to put a local area network (LAN) on the market to link a variety of desktop computers, printers, telecopiers, and electronic typewriters, enabling them to pass information back and forth. Xerox, Wang, and others already produce LAN systems. Some observers do not think this is necessary for IBM, stating that very few offices really need high-speed data communication capabilities between work stations, but others think an IBM network could add legitimacy to the market and possibly take it over completely.

Becker, Franklin, "Mixed Blessings: The Office At Home," *In Workspace: Creating Environments in Organizations*, Preager, New York, pp. 175- 202, 1981. Becker notes that there has been much speculation but little study of the office at home. The benefits of telecommuting may be significantly affected by individual differences in workers, such as their preferences, age, previous experience, specific responsibilities, and incentive and control systems.

Brandt, Stefan, "Working-At-Home: How to Cope with Spatial Design Possibilities Caused by the New Communication Media," *Office Technology and People* 2:1-3, 1983. A systematic approach to office design is presented, taking into account variations in the location of the workers and their affiliation. Brandt proposes that the future will offer more flexibility and increasing dispersion. The appropriate organization will depend on a detailed analysis of contingency or context factors, including communications processes, formal and informal structures, and technology.

Business Week, "The Potential for Telecommuting," January 26, 1981. Both the pros and the cons of telecommuting are presented here. The potential benefits for employees and for increased productivity are reviewed, yet uncertainties persist. F International Ltd. is a computer software company in which almost all of the employees work at home: they are productive and time is flexible, but there is a new form of discipline. The company has grown and prospered internationally. Initial skepticism has been overcome.

Cowan, William, "How Administrators View the "Work-At-Home Trend" *Office Administration and Automation*, pp. 28-31, 104-105, November 1983. The results of a survey of managers are reviewed: work at home is almost non-existent in large industries but does appear in newer, smaller, more experimental industries. Projects at the Federal Reserve Bank, Seybold Consulting, Office System Consulting, and the First National Bank of Boston are examined.

DeSanctis, Gerardine, "A Telecommuting Primer," *Datamation* 29(10):214-220, October 1983. Once again, the pros and cons of telecommuting are reviewed. Implementation issues, including security, zoning, work site conditions, supervision, compensation, tax, and training are discussed.

Dimieri, Thomas, et al, *Telecommuting: An Educational Brief*, Wang Advanced Systems Laboratories, 1984. A review of the literature and an annotated bibliography are presented.

Dullea, Georgia, "New Marital Stress: The Computer Complex," *The New York Times*, p. A17, January 10, 1983. This article suggests that even though it has some advantages, work at home may negatively impact family relations: the phenomenon of the "computer-widow" is described. Moreover, it is suggested that shy children who play continuously with computers may be learning programming skills at the expense of their social development.

Galt, Virginia, "Computer Work at Home Can Be a Curse and a Blessing," *The Globe & Mail*, July 3, 1984. Galt believes that telecommuting can save time and prevent various disruptions, thereby improving productivity. However, she has some concerns about the impact on women, fearing that telecommuting will increase their burden, expecting them to process a particular volume of work plus care for their family. Moreover, unions cannot easily organize home-workers, and they are, therefore, more prone to exploitation.

Gayman, Arden, "Telecommuters, Next Problem in the Workplace of the 1980's," *Office Equipment and Methods*, p. 54, June 1984. This article takes a brief look at the feasibility of telecommuting as well as its future, citing successful examples of telecommuters, while reviewing some of the drawbacks. Reference is made to M. Olson's typologies of the people who now work at home and to J. Nilles' predictions of increasing corporate interest in telecommuting.

Gil, Gordon, "Telecommuting Offers New Area for Greater Teleconferencing Growth," *Communications News*, February 1985. Gordon defines telecommuting and lists jobs where it can be used and different variations of it. He also pinpoints the main reasons for resistance, i.e., concerns about supervision and isolation. Two scenarios are provided as examples of how telecommuting may be used (using a combination of electronic mail, computer conferencing, and video conferencing for technical diagrams.) Gordon suggests integration of the wide range of teleconferencing and telecommuting methods.

Handy, Charles, "The Changing Shape of Work," *Organizational Dynamics*, pp. 26-34, Autumn 1980. Handy predicts that the new technology will transform the organization of work: organizations based on contractual arrangements and increased decentralization are expected. The contractual organization will be based on autonomous work groups which may be linked to a larger organization or organized as a co-operative of subcontracters. Potential impacts requiring further investigation include the way in which change is managed, the impact on career paths, and worker/employer relations.

Kelly, M., "Its Rush Hour for Telecommuting," *Business Week*, January 23, 1984. It is estimated that over 200 American companies are experimenting with telecommuting, but presently only 30 have formal programs. The chief benefits reported are improved productivity and fresh labour sources for employers and more flexibility for workers. There is some resistance to telecommuting because of the absence of visual supervision and technical problems, but technology is improving and costs are decreasing. There is strong backing from telephone companies, since it allows for increased residential rates, more business, and more equipment sales.

Khan, Ata, "Areas of Opportunity for the Use of Telecommunications to Substitute for or Complement Transportation," Ontario Ministry of Transportation and Communications, 1984. This study reviews opportunities to use telecommunications as a substitute or complement to transportation. Khan reviews the transportation/communication interrelationship with respect to transportation, land use, and special factors, as well as technological, planning, and institutional factors. He describes the standard substitution opportunities – teleconferencing, electronic mail, remote work, work at home, teleshopping, telemedicine, and teleducation – as well as complementarity opportunities – traffic improvements, transit information, fleet control, ridesharing, freight distribution, and urban planning. Finally, he suggests criteria which could be used to evaluate the opportunities (similar to those employed by the Mitre Corporation, such as user benefits, transportation industry benefits, telecommunication industry benefits, environ-

mental impacts, and energy impacts. He also proposes an evaluation mechanism.

Kraemer, Kenneth, "Telecommunications/Transportation Substitution and Energy Conservation," *Telecommunications Policy*, March 1982. Kraemer gives a brief reference to studies, discussing the suitability of teleworking to particular kinds of jobs. He reviews attitudinal and operational studies done to examine the degree of suitability of telework for travel in Los Angeles, California, and he also provides a summary of the results obtained from a series of interviews conducted with individuals from various organizations using telework (cf. Margarethe Olson). Kraemer maintains that telework has great potential to alter transportation/communications patterns but that realization of this potential will depend on a number of factors, including the action or inaction of government.

Lopez, David, and Gray, Paul, "The Substitution of Communication for Transportation – A Case Study," *Management Science*, July 1977. The possibilities of substituting communications for transportation in urban settings is investigated in this case study of an insurance company. An optimization model is developed for determining the number and the location of sites to be selected, and the results of the optimization are used as part of a cost/benefit analysis. It is concluded that such substitution is economically, operationally, and technically feasible for the firm and that such substitution would benefit many firms in the information industry. The model, analysis, and implementation of the results are examined.

Lunzer, Francesca, "Computer Economics," *Forbes*, p. 194, October 24, 1983. At the Federal Reserve Bank of Atlanta, productivity is estimated to have improved almost tenfold as a result of a reorganization of workers and the introduction of portable terminals.

Macrae, Norman, "How to Survive in the Age of 'Telecommuting'," *Management Review*, pp. 14-19, November 1978. Macrae anticipates that the impacts of telecommuting will be far-reaching, including reduced importance of centralized government, increased flexibility of life-style, and a move in business towards profit centres that are smaller and more entrepreneurial. Large corporations are expected to subcontract work to small-scale entrepreneurial industries, thereby diminishing the power of unions.

Mattera, Philip, "Home Computer Sweatshops," *The Nation*, pp. 390-392, April 2, 1983. According to Mattera, telecommuting may bring about a return to the piece rate way of payment and increased employee exploitation, particularly in clerical functions. It may also be used as a way of preventing workers from unionizing and keeping wages and security low. Although telework may have positive results for middle class professionals, the effects on the working class may be quite different.

McClintock, Charles, "The Telecommuting Adventure," *Human Ecology Forum* 13(3). McClintock presents the motivators for organizations to look into telecommuting: reduced travel costs, staggered schedules, and increased productivity. The potential for mismanagement with telecommuting is great, e.g., limits to advancement, no opportunities for unions, and benefits. A brief reference to the "electronic office" is made (pros and cons): social contacts may be actually increased, yet employees may have to work irregular hours; efficiency of communications; privacy, etc. Employers must remember their social responsibilities to their employees; otherwise, decreased productivity will occur. A research plan is proposed, including the following:

1/ documenting the variety of work settings in which telecommuting is occurring; the types of jobs, tasks, and work organizations; and characteristics of telecommuters;

2a/ work factors (e.g., methods of supervision, effects on communications, and motivation);

b/ social factors (interaction with family);

c/ economic factors;

d/ legal factors;

3/ study of organizations that are experimenting with telecommuting to gather data;

4/ study of self-employed telecommuters.

Nilles, Jack M., "Teleworking: Working Closer to Home," *Technology Review*, pp. 56-62, April 1982. Nilles reviews teleworking and notes that smaller, shared facilities may not suit a corporation's image and that corporate loyalty and identity may be

affected. He also emphasized benefits at the national level, such as fuel savings, reduced air pollution, energy self-sufficiency, and an expanded international labour pool.

_____, "Telecommunications and Energy," California Department of Energy, July 1983. This study is a comprehensive review of telecommunications technology and its potential impacts on the state of California. Technologies for telecommuting and teleconferencing are described and important trends reviewed. Travel patterns in the state and potential energy savings are quantified. Both barriers and incentives to the adoption of technologies are covered. Finally, Nilles developed forecasts of market growth and energy savings based on defined assumptions. He also outlines relevant public policy issues with respect to energy, information, transportation, economic growth, and government operations.

Nilles, Jack M., et al, "Telecommuting – An Alternative to Urban Transportation Congestion," *IEEE Transactions on Systems, Man, and Cybernetics* 6(2):77-84, February 1976. The authors investigate the impact, on a large insurance firm, of telecommunications and computer technology on transportation. Transportation patterns, population distribution, and the business contact requirements of one division are evaluated. The authors conclude that present communications and computer technology, in terms of "off-the-shelf" hardware and services, can offer an economical substitute for commuting. Questions of effectiveness, i.e., maintenance or improvement of productivity and acceptability of new working conditions on the part of the information industry workers, remain open. However, a related series of investigations of participants in interactive TV courses lead the authors to believe that worker productivity will at least be maintained and may well be improved through telecommuting. The evolution of work processes, from centralization through fragmentation to dispersion and diffusion, is considered.

Obermann, Richard, et al, *Initiatives for Conserving Transportation Energy Through Telecommunications*, Mitre Corp., June 1980. A list of initiatives for the concepts of work-at-home and satellite centres, with the aim of reducing transportation energy consumption, is presented. These initiatives comprise tasks having to do with analysis of the concepts, their demonstration, participant selection, implementation, incentives, and promotion. Their scheduling and feasibility are also briefly discussed, admitting the complexity of these tasks.

Olson, Margarethe H., "New Information Technology and Organization Culture," *MIS Quarterly, Special Issue*, 1982. Predictions of the effects of office automation on organizations vary widely. This article focuses on changes, i.e., individual work patterns, management control, and organizational structure that may occur as a result of implementation of office technology. The most significant change predicted is that organizations will no longer be limited by a central office work environment operating between the traditional office work hours of nine to five. Computer and communications technology will facilitate the relaxing of these physical constraints as necessitated by societal and economic pressures. Relevant research to date regarding the effects of the new technology on organizational behaviour is reviewed. Management guidelines for preparing for the coming changes are included.

_____, "The Impact of Office Automation on the Organization: Some Implications for Research and Practice," *Communications of the ACM*, November 1982. This paper presents a descriptive model of, and propositions concerning, the potential impacts of office automation on the organization and the need, when implementing automated office systems, to take a broad perspective of the potential positive and negative effects on the organization. The need for further research examining the potential effects of office automation is emphasized.

_____, "Remote Office Work: Changing Work Patterns in Space and Time," *Communications of the ACM* 26(3):182-187, March 1983. This paper examines some behavioural, organizational, and social issues surrounding remote work, particularly work at home. This study of 32 employees who worked at home revealed that the characteristics of their jobs included limited space and equipment needs, individual control over work space, defined deliverables, a need for concentration, and relatively limited need for communication. Individual characteristics included self-motivation, self-discipline, and skills which gave them bargaining power. They also made the arrangement, either because of family requirements or because they preferred few social contacts

beyond their own families.

_____, "Overview of Work-At-Home Trends in the US," *Communications of the ACM*, August 1983. Formal work-at-home programs based on analysis of 14 such programs that have occurred or are now taking place in companies in the US are reviewed. The author also documents a trend towards informal work-at-home arrangements negotiated on an individual basis (especially in leading-edge companies in high-tech industries).

Olson concludes that the primary motivation for business is economic. Individual employees choose telework because of the flexibility it offers. Usually, only those with skills in demand are in a position to request such special arrangements. Technology is a facilitator but not the driving force, as strong organizational "culture factors" help discourage it. The most pervasive impact will be "location independence." These companies are unique: exceptional employees in exceptional organizations. "In sum, we found little evidence, at least at this point, that companies in the future will encourage work at home for the same reason as the high-tech companies today." The following model represents a classification of types of work-at-home arrangements that may occur, based on the relationship between the employee and the organization:

	Skill Oversupply	Skill Undersupply
Contract/Piece Rate	Exploitation	Autonomy
Hourly/Salary	Trade-off	Privilege

Olson, Margarethe, and Tasley, Roberta, "Telecommunications and the Changing Definition of the Workplace," New York University, April 1983." The position of this paper is that technology can support either positive or negative implementations of remote office work; social and economic forces, as well as policy, provide the impetus for change in one direction or the other. The general conclusion of this paper is that the profound implications of remote office work are today not understood adequately enough for policy decisions to be made. It emphasizes work at home, and policy issues are considered. Two factors combine to determine the nature of the work-at-home arrangement:

1/ the degree to which the skill supplied by the employee is in demand;

2/ the method of payment for work performed.

The authors predict that work at home will be a relatively insignificant phenomenon, offered for special cases only. Other remote work options, such as neighbourhood work centres, will become even more attractive than they are now. An option for work at home is to view it as one of a broad set of remote work-at-home alternatives about which little is understood at present. A concentrated large-scale effort should be made to study the potential implications of it.

Pollock, Andrew, "Rising Trend of Computer Age: Employees Who Work at Home," *New York Times*, March 12, 1981. This initial article presents some of the standard pros and cons of working at home. Supervision of employees is a problem. Different forecasts are quoted: from 1 to 2% to as high as 15% of the work force will choose this alternative.

Pratt, Joanne, "Home Teleworking: A Study of Its Pioneers," *Technological Forecasting and Social Change* 25:1-14, 1984. The article includes the results of interviews with a sample of people who were performing office work on home computers in 1981. The article covers the following:

- the costs, benefits, and considerations for employees and employers;

- the pros and cons of monitoring performance at home;

- limitations of the present technology; and

-characteristics of the jobs and people now benefiting from off-site employment.

Other issues discussed include the following:

- characteristics of workers who returned to the office full-time or stopped working after rejecting homework;

- factors enhancing and inhibiting companies from promoting work at home; and

- attitudes of workers and supervisors currently in-

volved in off-site employment pilot programs.

Rosow, Jerome, and Zager, Robert, *New York Schedules for a Changing Society*, Scarsdale, New York, 1981. Management is now being forced to consider new work alternatives as demographic trends change and commuting costs rise. The authors stress that everyone can benefit from these new approaches.

Salomon, Ilan and Meira, "Telecommuting: The Employee's Perspective," *Technological Forecasting and Social Change* 25, 1984. This article evaluates the costs and benefits of work at home for the employee, employer, and society. Telework is discussed as a complete change in life-style, rather than simply a change in the way people work. Therefore, impact upon the household life-style, problems for interaction and evaluation through telecommunication facilities, the uneven distribution of effects among the parties involved, and the often neglected benefits of daily commuting are all elaborated upon.

Sample, Robert, "Coping with the Work-at-Home Trend," *Administrative Management* 42:24-27, August 1983. The article reviews Control Data's Alternate Worksites and Homework Program.

Surette, Ralph, "Power of Computers Makes Firm's Rustic Locale Possible," *The Globe & Mail*, January 1984. This article presents an example of a Nova Scotia company that is using telecommuting successfully: three scientists combine the Nova Scotia rural life with research and consultancy in technology management and software design. They discuss the benefits of this arrangement and their efforts to keep contacts.

Tangora, Joanne, "Telecommuting," *Working Women* 7(11):52-54, November 1982. This article is a short review of the implications of work at home for women.

Wolfgram, Tammara H. "Working at Home: The Growth of Cottage Industry," *The Futurist* 18(3):31-34, June 1984. The growing "cottage industries" are reviewed, focusing more on the kinds that are not involved with electronic communications. The possible reasons for this trend and the motivations of individuals who do work at home are discussed, including factors such as technological improvements, the desire to spend more time with children, savings in commuting expenses, and increased flexibility. Disadvantages and obstacles, such as zoning laws and institutional resistance, are also discussed, concluding that these are obviously not insurmountable. Wolfgram advocates a federal study of the social impact of cottage industry and of potential for its growth.

Zientra, Marguerite, "Telecommuting Banned by Service Union Board," *Computerworld*, July 11, 1983. Because of concern about worker exploitation, the Services Employees International Union banned telecommuting. The Centre on National Labour Policies is co-ordinating groups to petition to lift the ban.

Zuboff, Shashanah, "Computer-Mediated Work," *Office: Technology and People* 1, 1982. Computer technology makes work more abstract and can negatively affect clerical workers. A distinction is made between intrinsic characteristics of the technology and the design and organization of work.

appendix a/ preliminary estimates of selected impacts (comparative estimates based on 1980 base year)

Opportunity Area	Transportation Infrastructure Impacts – Reduction on Person Trips ($x10^6$)	Petroleum Fuel Saving Litres x 10^6/yr	Commercialization Time (yr)	Diffusion Time Horizon
Teleconferencing	Air: 0.50-2.52 Rail: 0.07-0.37	Air: 101-504 Rail: 2-10	3-4	1985-90
Remote Work Centre: Satellite Office	Auto: 20-80 Urban Transit: 2-8 Commuter rail: 0.2-0.8	Auto: 36-144 Transit: 0.8-3.2 Commuter rail: small	3-4	1985-90
Remote Work Centre: Home Office	Auto: 24-120 Transit: 2-12 Commuter rail: 0.1-0.4	Auto: 43-216 Transit: 0.8-4.8 Commuter rail: negligible	4-5	1990-2000
Teleshopping	Auto: 12-30 Transit: 1-3 Commuter rail: negligible	Auto: 22-54 Transit: 0.4-1.2 Commuter rail: negligible	4-6	1985-90
Telemedicine	Air: 0-0.023	Air: 0-5	3-4	1985-90
Telecourse	Auto: 0-4 Transit 0-0.4	Auto: 0-7 Transit 0-0.16	3-4	1985-90

Notes: Effectiveness estimates for transportation infrastructure impacts are calculated by using these data, as well as the following:

- Air: 1.65¢/passenger-km and average trip length: 1666 km.
- Rail: No infrastructure cost savings assumed.
- Auto: 1.32¢/passenger-km and average trip length of 14.5 km (urban/regional case).
- Urban Transit: No infrastructure cost savings assumed.

Source: Ata Khan [2]

appendix b/ telecommuting forecast

SUMMARY OF TELECOMMUTING SCENARIOS

	1980	1983	1985	1990	1995	2000
Total California Population	23 667 902	24 851 564	25 673 380	27 848 790	30 208 531	32 768 223
California Labour Force	10 640 405	11 172 545	11 542 010	12 520 011	13 580 883	14 731 646
Information Workers	6 141 035	6 563 942	6 861 938	7 667 470	8 567 564	9 573 320
LOW GROWTH AND ACCEPTANCE SCENARIO						
Telecommuters						
Full-time home	1228	2051	2 884	6 716	15 387	34 116
Part-time home-CBD	1842	4813	9 090	42 708	167 476	425 239
Part-time home-local centre	3071	4415	5 620	10 245	18 553	33 245
Part-time local centre-CBD	1535	2566	3 612	8 444	19 494	43 884
Full-time local centre	6141	8830	11 241	20 490	37 105	66 490
Average home-CBD mi (round trip)	19.4	19.4	19.4	19.4	19.4	19.4
Average home-loc. ctr. mi (RT)	9	9	8.4	8	7.2	6.6
NET ENERGY SAVED						
(M kWh)	47.6	60.8	78.5	161.2	366.8	894.0
(M gal gas)	1.3	1.7	2.1	4.4	10.0	24.4
INCREASE OVER 1980						
(M kWh)	0	13.2	30.8	319.2	319.2	846.3
(M gal gas)	0	0.4	0.9	8.8	8.8	23.1
NOMINAL GROWTH AND ACCEPTANCE SCENARIO						
Telecommuters						
Full-time home	1228	2 386	3 709	11 095	32 358	88 691
Part-time home-CBD	1842	6 493	14 925	108 192	469 772	861 309
Part-time home-local centre	3071	6 909	11 828	44 231	150 837	408 967
Part-time local centre-CBD	1535	2 978	4 623	13 725	39 273	103 054
Full-time local centre	6141	16 067	30 400	144 794	594 751	649 485
Average home-CBD mi (round trip)	19.4	19.4	19.4	19.4	19.4	19.4
Average home-loc. ctr. mi (RT)	9	9	8.4	8	7.2	6.6
NET ENERGY SAVED						
(M kWh)	48.2	97.2	174.2	727.4	2728.0	7504.0
(M gal gas)	1.3	2.6	4.8	19.9	74.5	204.9
INCREASE OVER 1980						
(M kWh)	0	49.0	126.0	679.2	2680.0	7456.0
(M gal gas)	0	1.3	3.4	18.5	73.1	203.5
HIGH GROWTH AND ACCEPTANCE SCENARIO						
Telecommuters						
Full-time home	1228	5 861	16 514	195 560	1 030 015	1 655 624
Part-time home-CBD	1842	10 189	31 510	412 182	1 459 661	1 893 611
Part-time home-local centre	3071	8 043	15 244	73 496	315 419	962 616
Part-time local centre-CBD	1535	5 386	12 283	82 538	286 872	448 711
Full-time local centre	6141	25 115	63 563	550 255	2 128 758	3 212 308
Average home-CBD mi (round trip)	19.4	19.4	19.4	19.4	19.4	19.4
Average home-loc. ctr. mi (RT)	9	9	8.4	8	7.2	6.6
NET ENERGY SAVED						
(M kWh)	48.2	171.0	448.8	4122.0	17 500.0	25 900.0
(M gal gas)	1.3	4.7	12.2	112.5	477.7	707.2
INCREASE OVER 1980						
(M kWh)	0	123.0	400.6	4073.0	17 452.0	25 853.0
(M gal gas)	0	3.4	11.0	111.3	476.4	706.0

Source: California Department of Energy